Tulsa District Zebra Mussels

Everett Laney, M.S., Biologist

1645 S. 101 E. Ave, Tulsa OK, 74128-4629, ATTN: PE-E

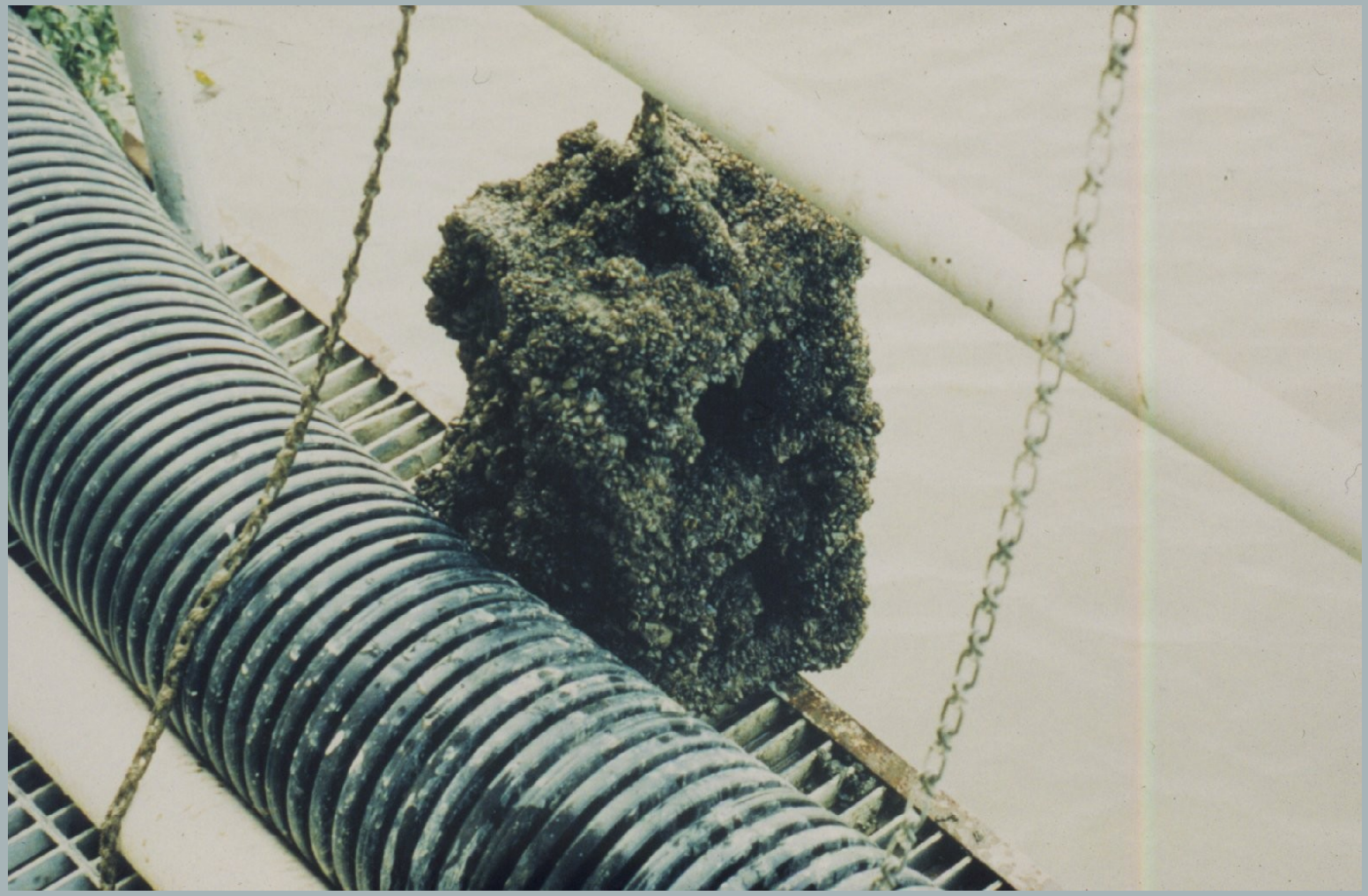
Ph: 918-669-7411 Fax: 918-669-7546

Everett.laney@swt03.usace.army.mil

Byssal Threads

Inside Pipe

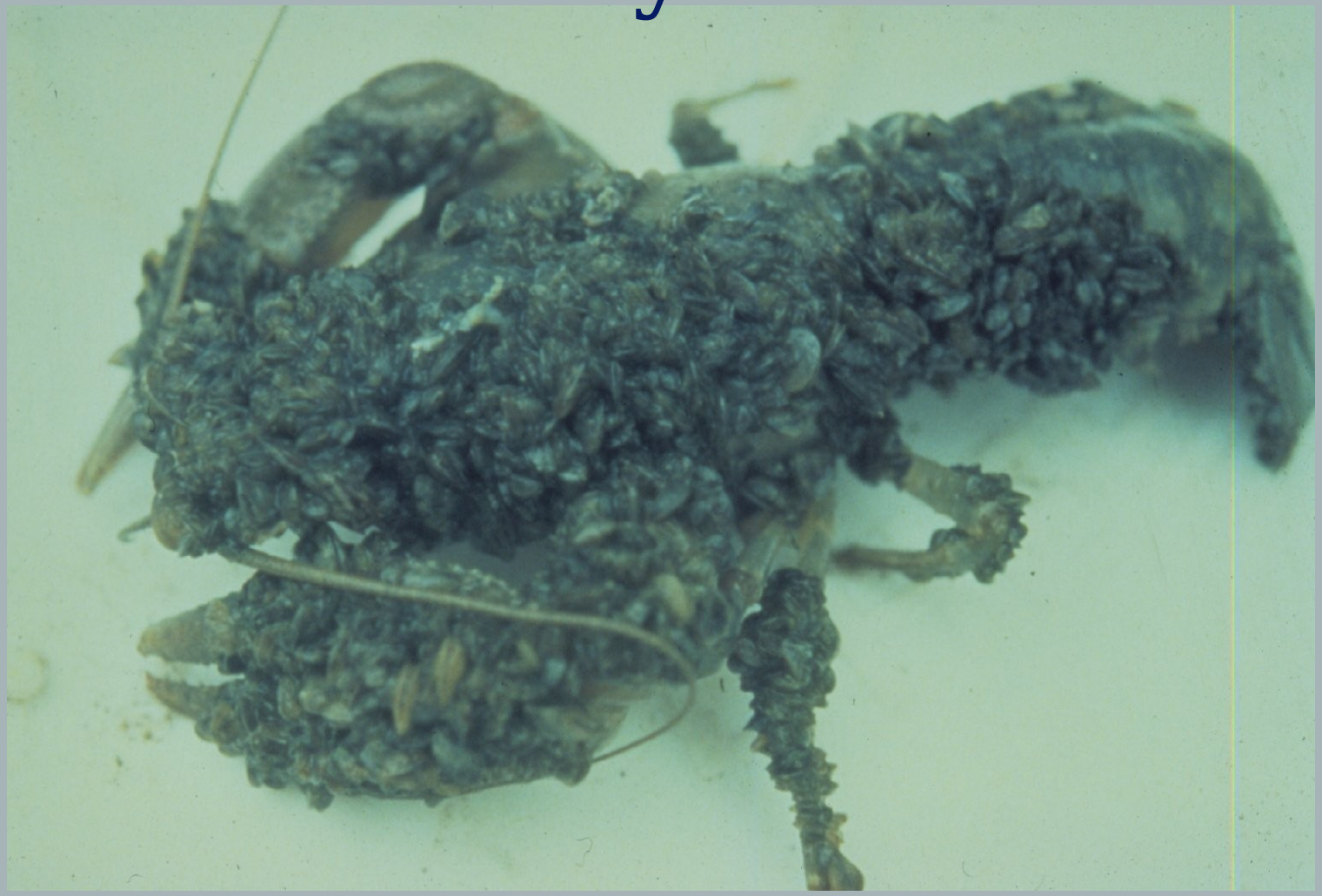
Recovered Concrete Block



Recovered Car

Oologah Lake ~ Native Mussel

Zebra Mussel on Crayfish



Oologah Lake ~ Shells on Shoreline

Oologah Lake ~ Toy Watergun

Authorities

- *Nonindigenious Aquatic Nuisance Prevention & Control Act of 1990 (Amended through P.L.106-580, 29 Dec 2000)*
- *National Invasives Species Act of 1996 (P.L. 104-332)*
- *Invasive Species Executive Order 13112, 3 Feb 1999*

Zebra Mussel Environmental Tolerances

VARIABLES	HIGH	MODERATE	LOW	VERY LOW
Dissolved Oxygen (ppm)	8 – 10	6 – 8	4 – 6	<4
Water Temperature (C/F)	18/64 – 25/77	16/61 – 18/64 25/77 – 28/82	9/48 – 25/77 28/82 –30/86	<8/46 >30/86
Total Hardness (mg CaCO3/l)	90 – >125	45 – 90	25 – 45	<25
Calcium (ppm)	25 – 125	20 – 25	9 – 20	<9
pH	7.5 – 8.7	7.2 – 7.5 8.7 – 9.0	6.5 – 7.2	<6.5 >9.0
Salinity (ppt)	0 – 1	1 – 4	4 – 10	10 – 35
Conductivity (μ Siemens)	83 – >110	37 – 82	22 – 36	>22
Turbidity (secchi disk cm)	40 – 200	20 – 40	10 – 20 200 – 250	<10 >250
Water Velocity (m/sec)	0.1 – 1.0	.09 – 0.1 1.0 – 1.25	.075 - .09 1.25 – 1.5	<.075 >1.5

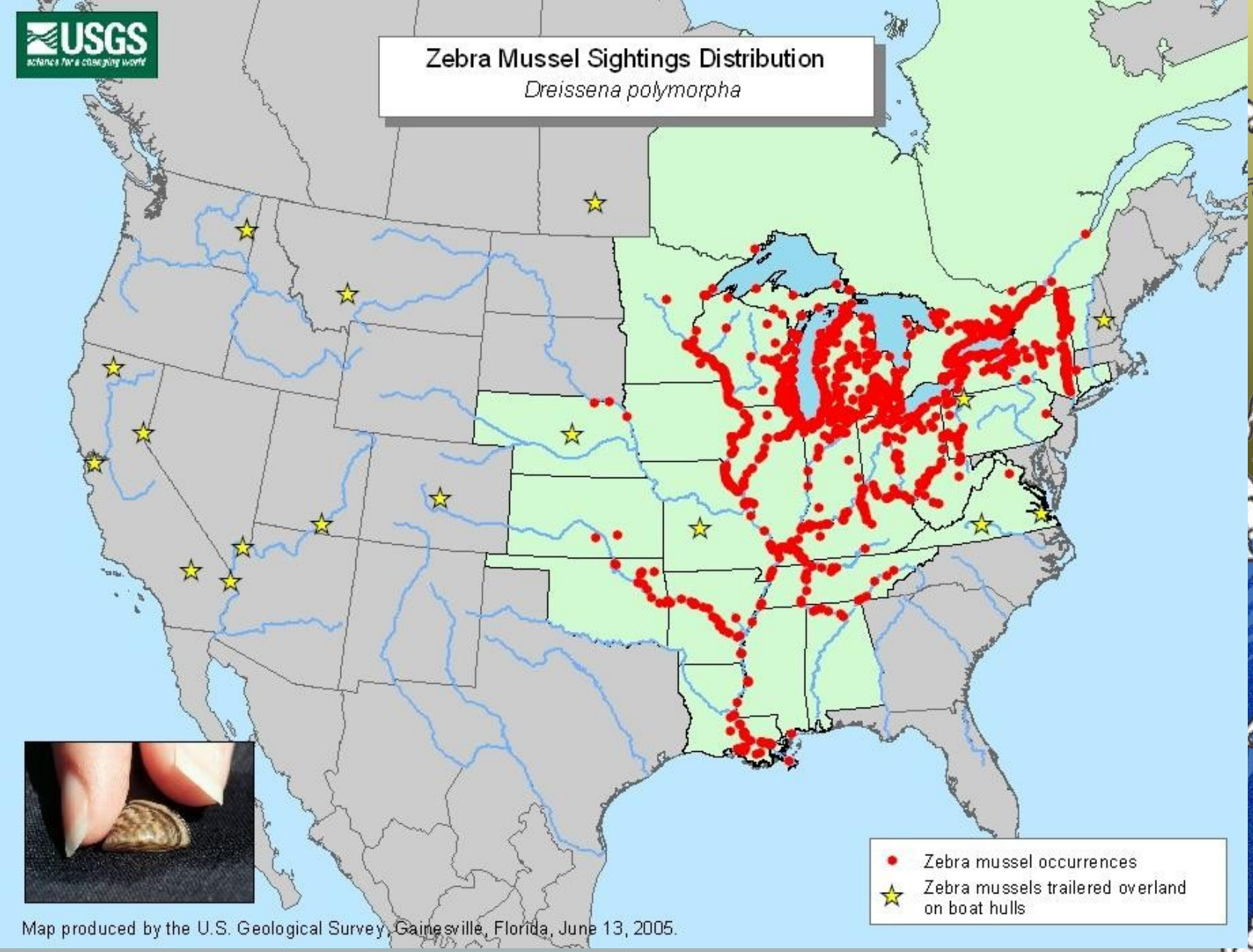
From European & North American Sources
Sea Grant, Mar 96

C.O'Neill, NY

Historical Biology

Cold-water species.

- *Spawn 1 or 2 times per season.*
- *Spawn from 54° to 80° F.*
- *Become stressed at 86° F, die within a few weeks.*
- *Die within 5 hours at 90° F.*
- *Grow @ 3mm/mo w/ @ 1 cm per year.*
- *Filter 1 liter of water per day.*

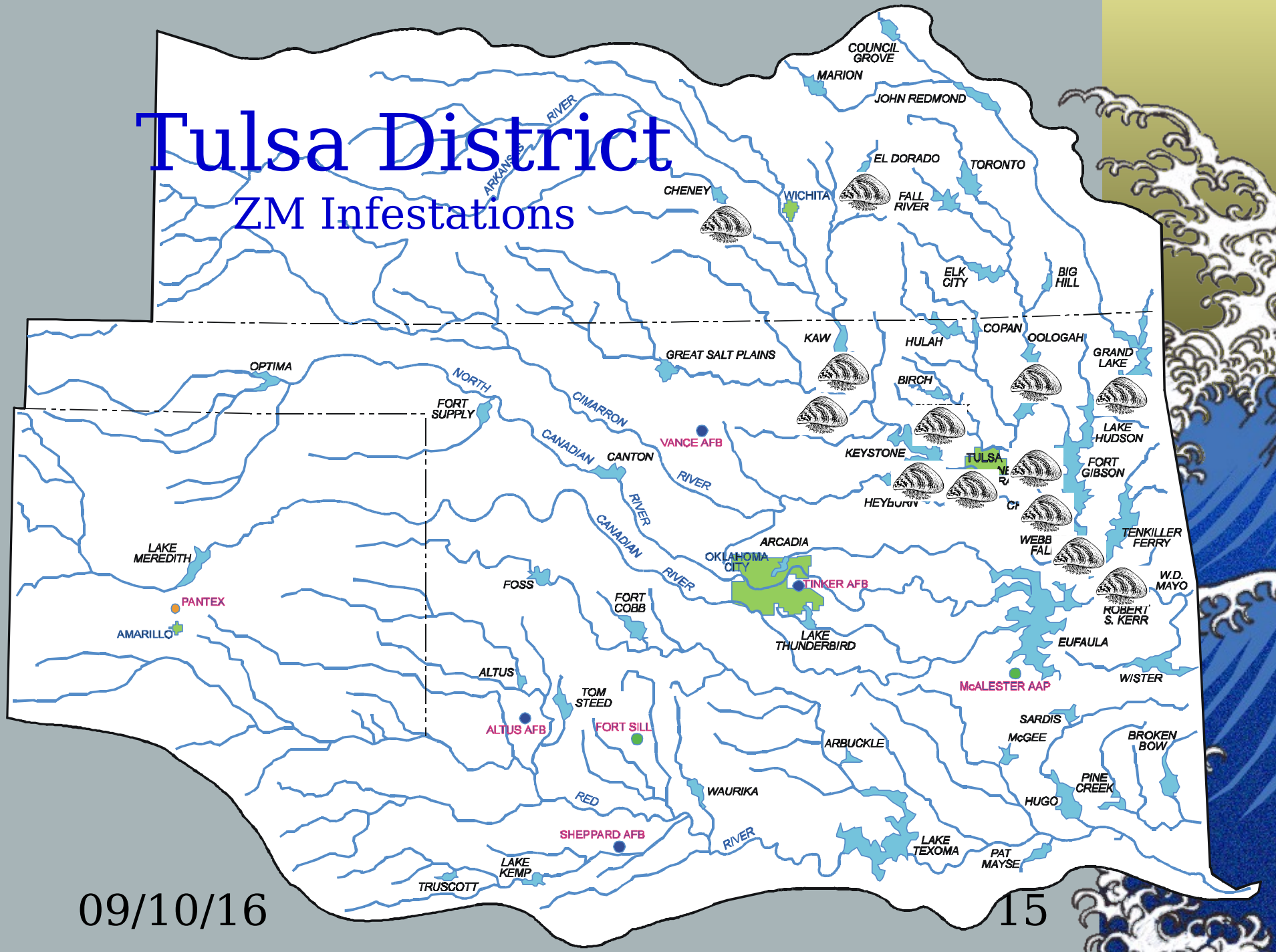

USGS
science for a changing world
Zebra Mussel Sightings Distribution
Dreissena polymorpha
Zebra mussel occurrences
Zebra mussels trailered overland on boat hulls
Map produced by the U.S. Geological Survey, Gainesville, Florida, June 13, 2005.

Tulsa District Infestation History

1. *Jan 1993 ~ W.D. Mayo, R.S. Kerr, and Webbers Falls locks (Ark River)*
2. *June 1993 ~ Chouteau Lock (Verdigris River)*
3. *Jan 1994 ~ Newt Graham Lock (Verdigris River)*
4. *June 2003 ~ Oologah Lake (Verdigris River)*
5. *June 2003 ~ Lynn Lane Lake (Tulsa Water Supply)*
6. *& A.B. Jewell Lake (Tulsa Water Supply)*
7. *Aug 2003 ~ El Dorado Lake, KS (Walnut River)*
8. *July 2004 ~ Kaw Lake (Arkansas River)*
9. *Aug 2004 ~ Cheney Lake, KS (one veliger)(Witchita Water Supply)*
10. *Oct 2005 ~ Keystone Lake (Arkansas & Cimarron Rivers)*
11. *May 2006 ~ OG&E Sooner Lake (water supply)*
12. *June 2006 ~ Skiatook Lake (Hominy Creek)(only once at dam)*
13. *June 2006 ~ Zink Lake in Tulsa (Arkansas River)*
14. *July 2006 ~ Grand Lake (Grand/Neosho River)(none found since)*
15. *& GRDA Chouteau Powerplant (water supply)*

Tulsa District

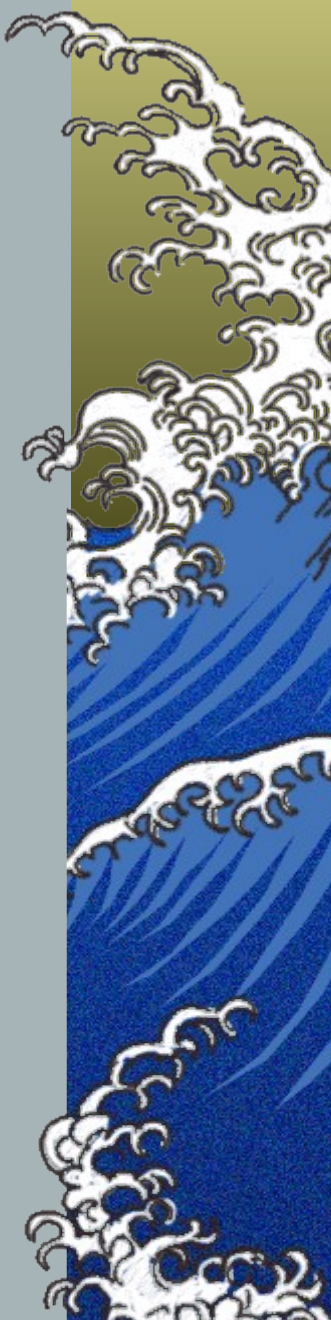
ZM Infestations



Northeastern State University Study_

McClellan/Kerr Navigation System ~ 1995

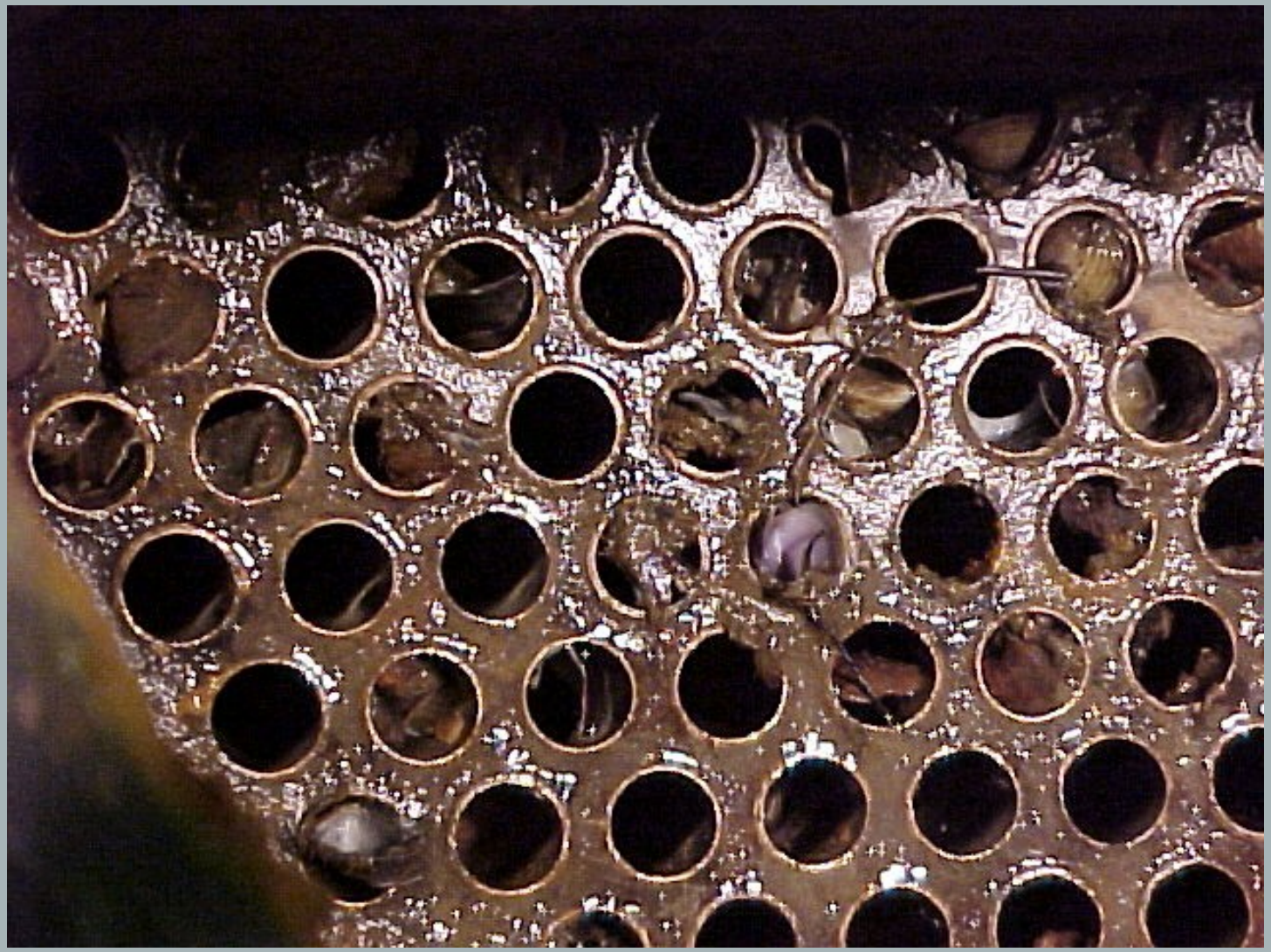
- *Late summer growth rates are slower that early summer at all sites.*
- *Water chemistry differences at sites may account for growth rate differences.*
- *The ranges for conductivity and calcium should support moderate to good growth at all sites.*
- *High temperature is probably limiting late summer growth at all sites.*
- *Early summer grow rates in Chouteau are slower, probably because of low pH.*
- *Early growth rates are much faster than cold waters.*
  - *Chouteau ~ 0.41mm/week*
  - *Webbers Falls ~ 1.19mm/week*
  - *R.S. Kerr ~ 1.03mm/week*



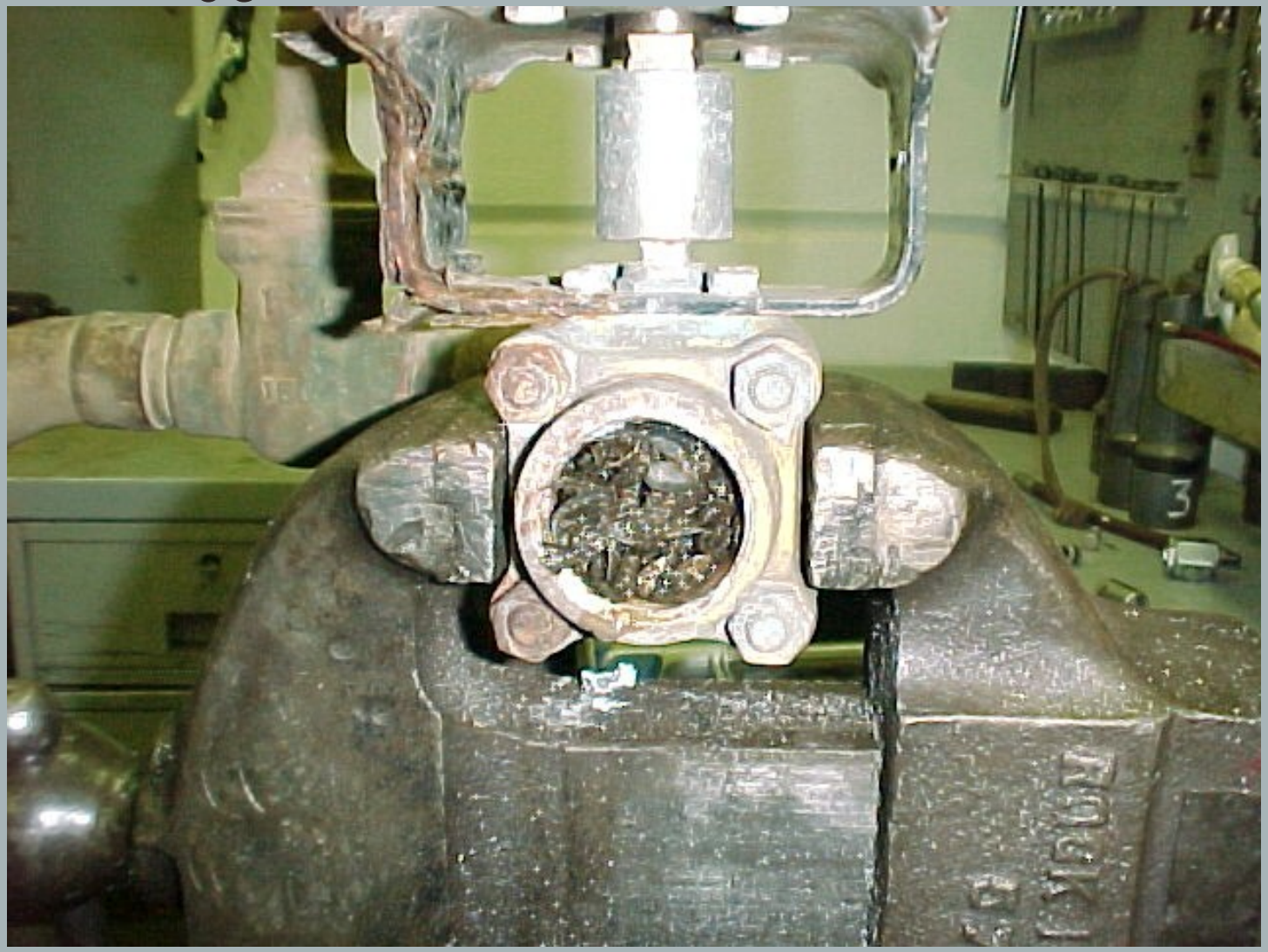
Current Cooperative Research

- *We have sent specimens to the Corps ERDC for genetic analysis to see where ours came from & if they have changed from the original species.*
- *The UT at Arlington is studying our specimens to see if they are more warm water tolerant than the original species.*
- *OSU is monitoring reproduction & densities in Oologah Lake.*

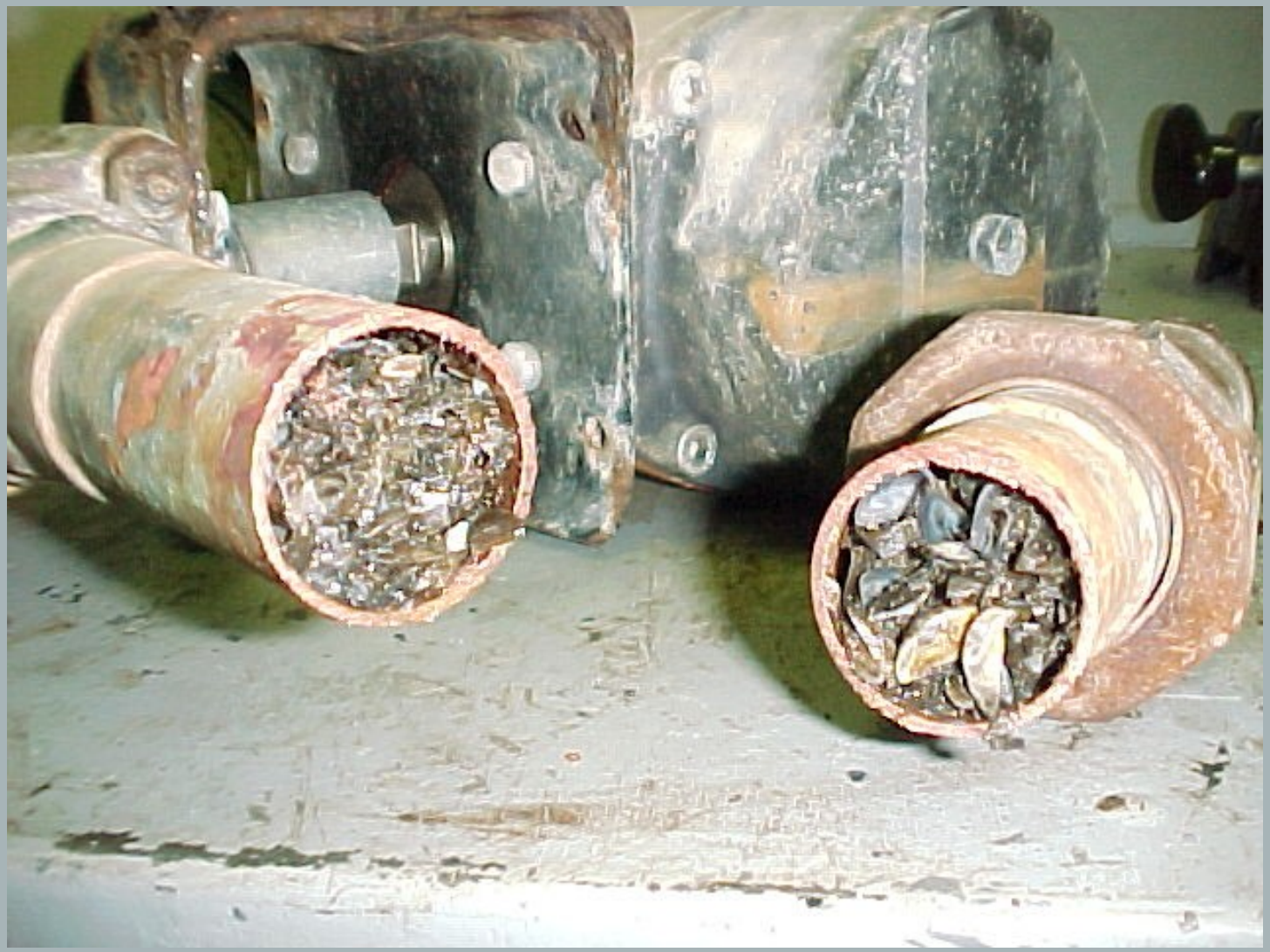
Robert S. Kerr ~ 1 May 02



Webbers Falls #2 Strainer ~ 18 Aug 06

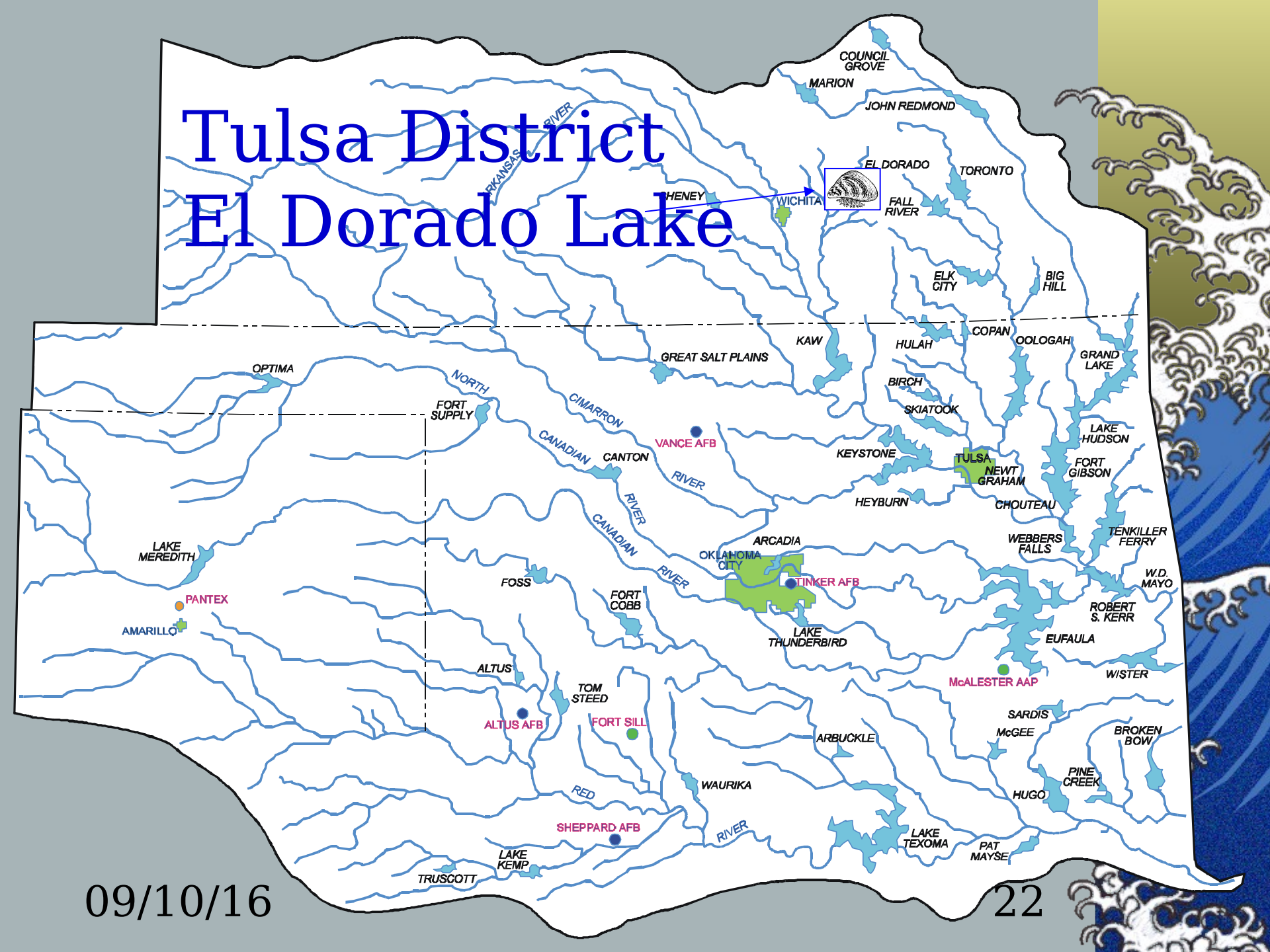


Webbers Falls #2 Strainer ~ 18 Aug 06



Webbers Falls #2 Strainer ~ 18 Aug 06

Tulsa District
El Dorado Lake



El Dorado Timeline

2001 infestation

Fall 2003 Discovery *50/m²*

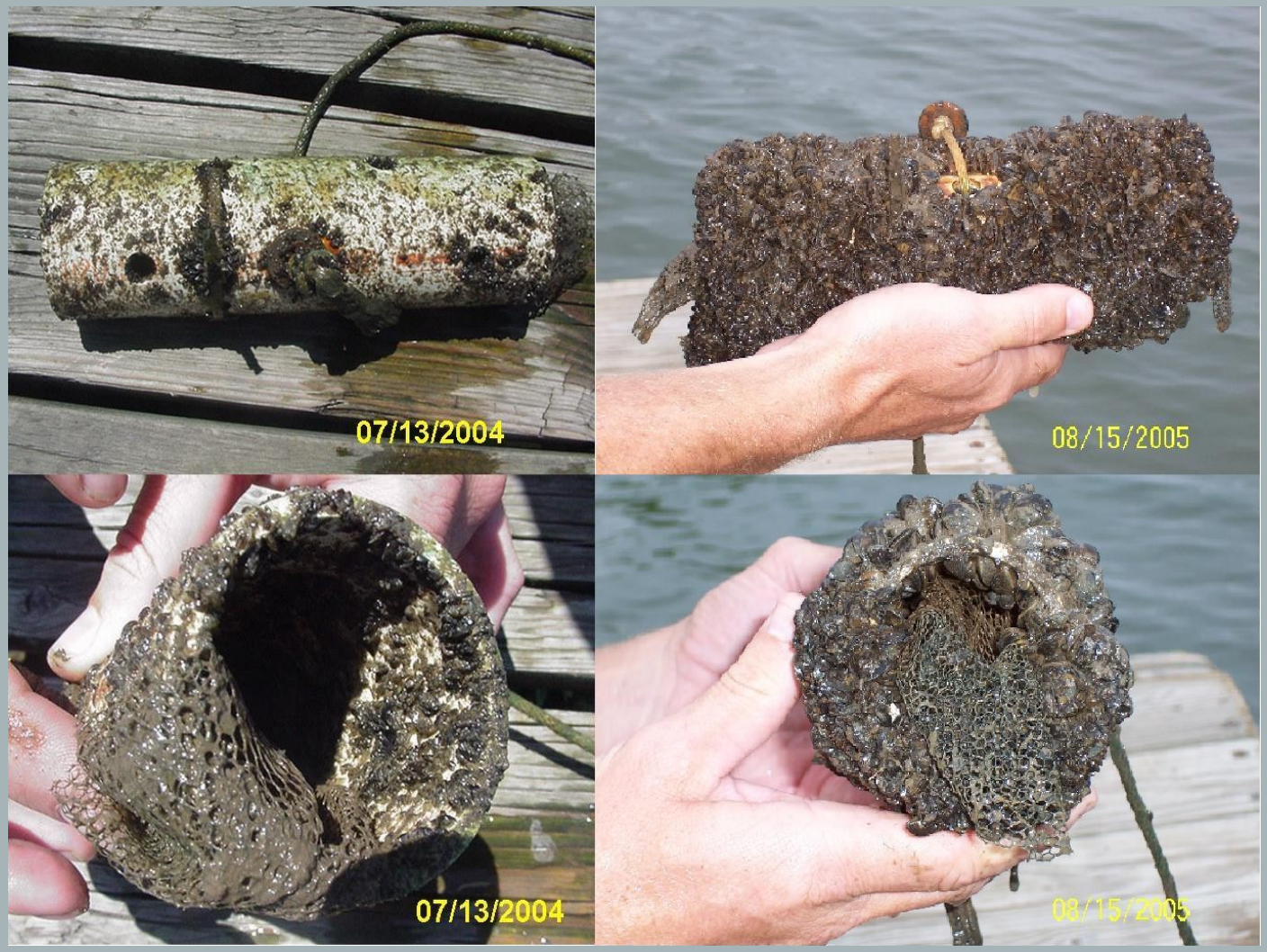
December 2003 *3½ ft lake drawdown*
135/m² in dry area

Fall 2004 sample *25,178/m²*

Jason Goekler, ANS Coordinator,
Kansas Dept of Parks & Wildlife
Email: jasong@wp.state.ks.us Ph: 620-342-0658

El Dorado Sampling

2004 ~ 2005



El Dorado Lake ~ 2003 Drawdown

Biological Reality

They like warm water!

- *Continuously spawning all summer.*
- *Some spawning in water over 89° F for 2-3 months.*
- *Surviving in water over 90° F for several weeks.*
- *Can grow 1.19-1.25mm/week = 1cm in @ 2 months.*
- *Since Zebra Mussels are as genetically diverse as cockroaches, will they morph?*

Therefore!

- *They will likely continue to be a nuisance and O&M expense for all water users.*
- *They apparently are more tolerant to the warm water environments than thought.*
- *Survivors could produce more tolerant offspring.*
- *Populations could increase again with more tolerant individuals. Perhaps as a new and larger subspecies?*
- *The warm water subspecies could infest and survive better in the inland southwestern lakes.*
- *Our Zebra Mussels could be the seed stock for infesting other western states.*

Infestation Threat from Overland Traffic for Six Tulsa District Lakes

	Ft. Gibson		Skiatook		Kaw		Oologah		Eufaula		Tenkiller	
	98	99	98	99	98	99	98	99	98	99	98	99
Opportunities	62	69	34	69	71	123	130	163	338	383	792	159 0
98 + 99	**131**		**103**		**194**		**293**		**721**		**2382**	
Total Other States	27	28	26	27	35	35	38	39	41	41	35	3[illegible]
Infested States	**15**	**14**	**13**	**13**	**15**	**15**	**16**	**16**	**16**	**16**	**16**	**15**
% of Infested States	**56%**	**50 %**	**50 %**	**48 %**	**43 %**	**43 %**	**42 %**	**41 %**	**39 %**	**39 %**	**46 %**	**43 %**
1998 Visitors	2,892,770		558,190		700,309		1,259,319		2,518,344		1,215,872	
1999 Visitors	2,416,651		585,843		UNKNOWN		1,258,023		2,127,130		1,149,237	
% f/ Infested States 1998	**0.000021**		**0.000124**		**0.000176**		**0.000129**		**0.000152**		**0.001308**	
% f/ Infested States 1999	**0.000029**		**0.000118**		**UNKNOWN**		**0.000130**		**0.000180**		**0.001384**	

Texoma Potential for Infestation by Overland Traffic

Red River Arm

- ✓ *Summer water temp occasionally exceeds 86F*
- ✓ *Salinity may keep them from surviving*
- ✓ *Also, the pH runs a little high*

Washita Arm

- ✓ *Summer water temp occasionally exceeds 86F*
- ✓ *Stratification with 6.2-8.0 DO to 12M Jun – Sep*

Tulsa District Program

- *Continue to provide I&E and PR about Zebra Mussels, and other invasive species.*
- *Continue to monitor densities & reproduction.*
- *Continue to monitor lakes for new infestations.*
- *Continue to support studies (biology, adaptation, water quality, monitoring, controls, etc.)*
- *Continue to keep current with technology for controls.*
- ***Be prepared for adverse impacts to facilities.***

Portland Samper

Some Controls

- *Prevention in #1 Priority*
- *Chemicals*
- *Biocides*
- *Heat*
- *Toxic Metals (copper, bronze, zinc, gold, etc)*
- *Surface Coatings*
- *Physical Removal*
- *Water Speed (over 6.6cfs)*
- *Freezing*
- *Filters*
- *Electrical Barriers*
- *Cathodic Barriers*
- *Ozone*
- *UV Light*
- *Acoustics*

Boating Recommendations for Infested Waters

- ***Run your boat at high speed for 10-15 minutes just prior to leaving the lake.*** *Zebra Mussels may be washed off at speeds exceeding 5 mph and larval Zebra Mussels will be flushed from the cooling system.*
- ***Remove any visible vegetation*** *from boat, motor, trailer, and any equipment in contact with the water.*
- ***Inspect equipment for presence of Zebra Mussels immediately upon leaving the lake.*** *If you find Zebra Mussels attached, wash with hot water (140˚) or air dry for at least 5 days before returning to the water. If equipment feels gritty to the touch, young microscopic Zebra Mussels may be attached. Power sprayers will detach Zebra Mussels.*
- ***Drain all bilge water, live wells, engine water, and bait buckets before leaving the lake.*** *Empty bait buckets on land. Never release live bait in the water.*
- ***Flush engine cooling system, live wells, and bilge with hot water.*** *Water hotter than 110˚ will kill larvae and hotter that 140˚ will kill adults.*
- ***Air dry your boat and other equipment for 5 days before using in uninfested waters.***

Suggested Web Sites

- *http://www.aquaticinvaders.org*
- *http://100thmeridian.org*
- *http://answest.fws.gov*
- *http://nas.er.usge.gov/zebramussel*
- *http://www.seagrant.noaa.gov*
- *http://www.wes.army.mil*
- *http://www:protectyourwaters.net*
- *"Or just search for **zebra mussel**"*

Other Invasives

Check Federal and State Invasive Species Lists for additional non-native species.

http://www.aphis.usda.gov/ppq/weeds/weedlist2006.pdf

http://www.invasivespeciesinfo.gov/laws/statelaws.shtml